

IN THE CLAIMS

1. (currently amended) A method of forming a semiconductor layer structure, said method comprising:

forming a modulation doped layer structure atop at least a portion of another layer by forming at least one sub-layer of doped nitride semiconductor and at least one sub-layer of undoped nitride semiconductor atop the at least portion of said another layer whereby said such that the resulting modulation doped layer structure has an overall doping concentration of at most 2E16 cm⁻³.

2. (original) A method as claimed in claim 1 wherein said forming step includes forming alternating sub-layers of doped nitride semiconductor and undoped nitride semiconductor atop the at least portion of said another layer.

3. (original) A method as claimed in claim 1 wherein said forming step is carried out by a process selected from the group consisting of reactive sputtering, metal organic chemical vapor deposition (MOCVD), molecular beam epitaxy (MBE) and atomic layer epitaxy.

4. (previously presented) A method as claimed in claim 1 wherein said forming step includes diffusing dopants from said sub-layer of doped nitride semiconductor into said sub-layer of undoped nitride semiconductor to form said modulation doped layer whereby said modulation doped layer has a doping concentration that is substantially uniform along its depth.

5. (original) A method as claimed in claim 1 wherein said modulation doped layer includes a gallium nitride-based semiconductor.

6. (original) A method as claimed in claim 1 wherein said modulation doped layer includes GaN.

7. (original) A method as claimed in claim 1 wherein said modulation doped layer is n-type.

8. (original) A method as claimed in claim 1 wherein said modulation doped layer has a doping concentration of at least $4E15\text{ cm}^{-3}$.

9. (original) A method as claimed in claim 1 wherein said modulation doped layer has a thickness of at least 0.2 μm .

10. (original) A method as claimed in claim 1 wherein said modulation doped layer has a thickness of at most 10 μm .

11. (original) A method as claimed in claim 1 wherein said doped sub-layer of said modulation doped layer has a thickness of at least 0.005 μm .

12. (original) A method as claimed in claim 1 wherein said doped sub-layer of said modulation doped layer has a thickness of at most 0.1 μm .

13. (original) A method as claimed in claim 1 wherein said undoped sub-layer of said modulation doped layer has a thickness of at least 0.005 μm .

14. (original) A method as claimed in claim 1 wherein said undoped sub-layer of said modulation doped layer has a thickness of at most 0.1 μm .

15. (original) A method of forming a Schottky junction including forming a modulation doped layer as claimed in claim 1 and forming a metal contact layer atop said modulation doped layer.

16. (original) A method of forming a Schottky diode including forming a Schottky junction as claimed in claim 15 and forming an ohmic contact on another portion of said another layer.

17. (currently amended) A method of forming a Schottky diode, said method comprising:

forming a modulation doped layer structure atop at least a portion of another layer by forming alternating

sub-layers of doped nitride semiconductor and undoped nitride semiconductor atop the at least portion of said another layer such that the resulting modulation doped layer structure has an overall doping concentration of at most 2E16 cm⁻³;

forming a metallic contact layer atop at least part of said modulation doped layer to form a Schottky junction therewith; and

forming at least one further metallic contact layer on at least part of said another layer in substantially ohmic contact therewith;

whereby a ratio of an on-resistance of said Schottky diode to a breakdown voltage of said Schottky diode is at most $2 \times 10^{-5} \Omega \cdot \text{cm}^2/\text{V}$.

18. (cancelled)

19. (original) A method as claimed in claim 17 wherein said step of forming a modulation doped layer is carried out by a process selected from the group consisting of reactive sputtering, metal organic chemical vapor deposition (MOCVD), molecular beam epitaxy (MBE) and atomic layer epitaxy.

20. (original) A method as claimed in claim 17 wherein said modulation doped layer includes a gallium nitride-based semiconductor.

21. (original) A method as claimed in claim 17 wherein said modulation doped layer includes GaN.

22. (original) A method as claimed in claim 17 wherein said modulation doped layer is n-type.

23. (original) A method as claimed in claim 17 wherein said modulation doped layer has a thickness of at least 0.2 μm .

24. (original) A method as claimed in claim 17 wherein said modulation doped layer has a thickness of at most 10 μm .

25. (original) A method as claimed in claim 17 wherein said doped sub-layer of said modulation doped layer has a thickness of at least 0.005 μm .

26. (original) A method as claimed in claim 17 wherein said doped sub-layer of said modulation doped layer has a thickness of at most 0.1 μm .

27. (original) A method as claimed in claim 17 wherein said undoped sub-layer of said modulation doped layer has a thickness of at least 0.005 μm .

28. (original) A method as claimed in claim 17 wherein said undoped sub-layer of said modulation doped layer has a thickness of at most 0.1 μm .

29. (previously presented) A method as claimed in claim 17 wherein said metallic contact layer is selected from the group consisting of platinum (Pt), palladium (Pd), and nickel (Ni).

30. (previously presented) A method as claimed in claim 17 wherein said another layer comprises another doped layer of nitride semiconductor, and said method further comprises forming said another layer atop a substrate prior to said step of forming said modulation doped layer atop said at least portion of said another layer, said modulation doped layer and said another layer being of the same conductivity type, said another layer being more highly doped than said modulation doped layer.

31. (original) A method as claimed in claim 30 wherein said another doped layer includes a gallium nitride-based semiconductor.

32. (original) A method as claimed in claim 30 wherein said another doped layer includes GaN.

33. (original) A method as claimed in claim 30 wherein said another doped layer is n-type.

34. (original) A method as claimed in claim 30 wherein said another doped layer has a doping concentration of at least $4E18 \text{ cm}^{-3}$.

35. (original) A method as claimed in claim 30 wherein said substrate is selected from the group consisting of sapphire, silicon carbide, doped silicon and undoped silicon.

36. (original) A method as claimed in claim 17 wherein said ohmic metal contact layer is selected from the group consisting of aluminum/titanium/platinum/gold (Al/Ti/Pt/Au) and titanium/aluminum/platinum/gold (Ti/Al/Pt/Au).

37.-70. (cancelled)

71. (currently amended) A method of forming a Schottky diode, said method comprising:

forming a lower layer of n-type doped nitride semiconductor atop a substrate;

forming an upper layer structure atop at least a portion of said lower layer of nitride semiconductor by forming alternating sub-layers of n-type doped nitride semiconductor and undoped nitride semiconductor such that the resulting upper layer structure has an overall doping concentration of at most $2E16 \text{ cm}^{-3}$, said sub-layers being formed by a process selected from the group consisting of reactive sputtering, metal organic chemical vapor deposition (MOCVD), molecular beam epitaxy (MBE) and atomic layer epitaxy, said lower layer of nitride semiconductor being more highly doped than said upper layer of nitride semiconductor;

forming a first metal contact layer atop said upper layer structure of nitride semiconductor such that a Schottky contact is formed; and

forming a second metal contact layer atop said lower layer of nitride semiconductor such that an ohmic contact is formed;

whereby a ratio of an on-resistance of said Schottky diode to a breakdown voltage of said Schottky diode is at most $2 \times 10^{-5} \Omega \cdot \text{cm}^2/\text{V}$.

72. (original) A method as claimed in claim 71 wherein at least one of said upper layer of nitride semiconductor and said lower layer of nitride semiconductor includes a gallium nitride-based semiconductor.

73. (original) A method as claimed in claim 71 wherein at least one of said upper layer of nitride semiconductor and said lower layer of nitride semiconductor includes GaN.

74.-76. (cancelled)